DEPARTMENT OF THE NAVY
NAVAL WEAPONS STATION YORKTOWN
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WPNSTA YORKTOWNINST 11360.1E
PWC
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NAVAL WEAPONS STATION YORKTOWN INSTRUCTION 11360.1E

Subj: INSPECTION AND TESTING OF LIGHTNING PROTECTION AND GROUNDING SYSTEMS FOR ORDNANCE FACILITIES

Ref: (a) NAVSEA OP-5, Vol. 1 (Latest Revision)
(b) MIL-HDBK 1004/6 Military Handbook of 30 May 88
(c) NFPA780 Lightning Protection Systems
(d) 25TA Biddle Manual on Earth Resistance
(e) NFPA 70 National Electric Code (Latest Revision)

Encl: (1) Procedure for Performing Visual Inspection of Lightning Protection and Grounding Systems
(2) Procedure for Testing Conductive Floors
(3) Procedure for Testing Primary and Secondary Grounding Systems
(4) Procedure for Personnel Performing Grounding Tests

1. Purpose. To identify Naval Weapons Station Yorktown (WPNSTA Yorktown) responsibilities, requirements, and test procedures for the inspection, testing, maintenance, and repairs of the lightning protection and grounding systems for ordnance facilities. This program was established per the requirements in references (a) through (e) and became effective 1 December 1991. Enclosure (1) contains the specific procedure for performing visual inspection on lightning protection and grounding systems. Enclosure (2) contains the specific procedure for testing conductive floors. Enclosure (3) contains the specific procedure for testing primary and secondary lightning protection systems. Enclosure (4) contains the specific electrical step-by-step procedures performed by personnel on lightning protection and grounding systems.

2. Cancellation. WPNSTA YORKTOWNINST 11360.1D

3. Scope. This instruction provides procedures for visually inspecting and electrically testing grounding systems for all primary girdles, secondary girdles, ordnance grounds, static grounds, power grounds, instrumentation grounds, structural grounds, conductive floors, metal masses, conductive mats, electrical equipment, machinery, and all other devices that are part of the lightning protection system. All visual inspections and electrical testing will be per this instruction and references (a) through (e).

4. Operational Responsibilities.

a. The Regional Engineer (RE) or his designated representative will have overall responsibility for all aspects of the lightning protection and ground systems program as it relates to Class 1 (Land) and Class 2 (Facilities) property. Any and all management/monitoring aspects of this program as they relate to "equipment" or "personal property" (conductive mats, portable electrical equipment, machinery, and other portable devices) are the responsibility of the cognizant command, which shall maintain any documentation required by reference (a).

b. Regional Engineer will:

(1) Manage the inspection and testing program for the lightning protection and grounding systems.

(2) Set up and issue to the NAVFAC MIDLANT Yorktown Site, a grounding system test plan for the visual and electrical testing of primary and secondary ground systems components. The specific grounding test plan for an ordnance facility (operating buildings, magazines, explosives piers, etc.) shall identify the ground system test locations along with a listing of items to be tested and the type of test to be conducted.

(3) Collect all inspections and test data. Review test data, issue paper work to correct discrepancies and maintain test data for a minimum of six test cycles.

(4) Ensure proper paperwork is issued for visual and electrical testing of lightning protection and ground system every month when required, and every 6 and 24 months, as scheduled.

(5) Work with NAVFAC MIDLANT shops to gain access to building and notify the Peninsula Storefront for Safety when unable to gain scheduled access.

(6) Issue a work authorization/test plan to the NAVFAC MIDLANT shops to test new lightning protection systems for buildings requiring a monthly test. Issue a checklist for each building with test points identified.

(7) Receive and analyze all test data to determine that all referenced specifications are met. Prepare a work authorization test plan as needed to repair or replace grounding systems and monitor test data for trend development.

(8) Enter all required data in Lightning & Grounding Database.

(9) Issue/identify test points for all explosive buildings and magazines.

(10) Provide the building supervisor with a current copy of all lightning protection and grounding system inspection test results.

c. NAVFAC MIDLANT Engineering Division will:

(1) Assure drawings are available for all new explosive buildings, magazines, new additions, and replacement of equipment including all necessary bonding, grounding, and lightning protection requirements, per references (a) through (e).

(2) Assist other organizations with technical advice.

(3) Provide scale drawings of each facility (operating building, magazine, explosives pier, etc.) in the lightning protection and grounding system test program. These drawings will be included as a part of the specific test plan for each facility.

d. NAVFAC MIDLANT Shops will:

(1) Visually inspect all primary and secondary grounding systems (ordnance ground, static ground, instrumentation ground, electrical ground, structural ground, conductive floors, metal masses, gates, surge protection devices etc.) every 6 months.

(2) Perform an electrical continuity test on all ground reels and on all conductive floors every 24 months.

(3) Perform electrical test on all primary lightning protection systems, secondary grounding systems including ordnance ground, static ground, instrumentation ground, electrical ground, structural ground, metal masses, grab bars, gates, etc., every 24 months, and new buildings every 30 days for the first year (within 1 month, weather permitting).

(4) Document all test results on Ground System Test Plan and forward one copy to the RE.

(5) Immediately repair discrepancies found during electrical inspection or record all discrepancies that cannot be immediately corrected at time of inspection.

(6) Spot-check electrical equipment and installation when performing visual inspection. Record discrepancies that cannot be corrected during visual inspection.

(7) Verify that the ordnance ground and instrumentation grounds are clearly marked to preclude the misidentification of each.

(8) Provide training for all personnel performing visual inspection and electrical testing of lightning protection and grounding systems in accordance with Appendix D of reference (a). Assign only qualified personnel to perform tests and inspections.

(9) Provide personnel performing visual inspections and electrical testing of lightning protection and ground systems with a grounding system test plan for each ordnance facility. The inspection plan must identify inspection points and shall be signed by individual performing the inspection.

(10) Notify the Peninsula Storefront for Safety immediately when a lightning protection system is found defective and cannot be repaired.

e. The Resident Officer in Charge of Construction (ROICC) Office will:

(1) Monitor contract work closely to make sure that grounding systems are not painted over, dismantled, or damaged by contractors.

(2) Assure that when new metal doors, door frames, metallic masses (400 square inches or larger), gutters, downspouts, etc., are replaced, the contractor will install or replace grounding as required by reference (a).

(3) Assure new facilities have proper grounding systems per reference (a) through (e) and notify the RE to place facilities on ground test schedule.

(4) Assure no excavation work is performed in the vicinity of ordnance facilities (buildings/magazines) before identifying the location of the primary and secondary girdles.

f. Ordnance Handling Maintenance and/or Storage Departments of Tenant Commands will:

(1) Notify the RE, in writing, of any new equipment to be installed in ordnance facilities (buildings/magazines) that will require grounding/bonding.

(2) Notify the RE, in writing, when new facilities or modification to existing facilities are ready to have the lightning protection/grounding systems inspected and tested.

(3) Ensure that all explosive-operating facilities, storage facilities, piers, open storage pads and testing facilities with lightning, electrical and electrostatic grounding systems are made available to NAVFAC MIDLANT shop for inspection, maintenance, repairs, and testing.

(4) Ensure that any building the NAVFAC MIDLANT shops have not been able to gain access to, be rescheduled within 5 workdays after notification.

(5) Ensure that building supervisors issue Trouble Calls or Minor Work Orders through the RE to make repairs and perform testing as needed.

(6) Ensure that waivers are obtained as needed prior to issuing work to RE for execution.

(7) Ensure that all explosive-operating facilities with lightning or electrical/electrostatic grounding systems observed to have problems are immediately documented, brought to the attention of management and repaired as needed, before resuming operations.

(8) Ensure that FAILED grounding systems, FAILED conductive floors, and damaged portable grounding straps are repaired and tested or tagged out of service before resuming operations.

(9) Ensure their personnel notify the RE, in writing, of any new building, addition, or new equipment installed requiring bonding/ground.

NOTE: Tenants are responsible for the management/monitoring of all aspects of this program as they relate to "equipment" or "personal property" (conductive mats, portable electrical equipment, machinery, and other portable devices).

g. Building Supervisors shall:

(1) Ensure the following are conducted on a daily basis:

(a) Personnel inspect portable ground cables for damage and proper inspection dates before each use.

(b) No portable ground cables are connected to cause a ground loop.

(2) It is strongly recommended that production building supervisors conduct a quarterly "unofficial" visual inspection of their facilities using the inspection plan provided by the RE to make sure the lightning protection/grounding systems are undamaged and secured. Inspect for the following:

(a) Look at the base of lightning masts and inspection test points to assure ground cables are secured.

(b) Assure all portable and attached grounding straps are secured, properly attached, and tested and tagged with proper inspection dates.

(c) Perform a tug-test on bonding straps.

(d) Inspect the ordnance and instrumentation ground to make sure they are securely fastened to walls, are isolated (where possible), and are not damaged. Assure all ground systems are properly identified.

(e) Assure ordnance and static ground connections to work tables, cans, etc., which are used in explosives processing are secured.

(f) If any alterations are made to the lightning protection systems, grounding systems, or if any soil is disturbed, contact RE to verify grounding system is intact.

(g) Post in a conspicuous place any notification of test failure and curtail operations as appropriate.

(3) Brief the test team on any explosive hazards that may exist in the building at the time of the test.

(a) Document briefing on forms provided by RE. (A copy of this document will be provided to building supervisor with the grounding and lightning protection test results upon request.)

Note: Appendix D of reference (a) states, "Civilians/personnel assigned to positions involving daily responsibilities for ammunition and explosives shall have the applicable training or shall be scheduled to complete the training as a condition of employment." NAVFAC MIDLANT personnel who have attended the Electrical Explosive Safety for Naval Facilities (AMMO-29) course will be the only personnel authorized to perform the electrical tests on lightning protection and grounding systems.

(4) Ensure that the ordnance ground and instrumentation grounds are clearly marked to preclude the misidentification of each.

(5) Ensure that the next electrical test due date for Ordnance Ground Reels is clearly indicated in each area containing Ordnance Ground Reels.

(6) Issue Trouble Calls or Minor Works to correct deficiencies noted on 24 month Electrical Test Forms or 6 month Visual Inspection Forms and provide waivers as needed to make repairs.

h. The Peninsula Storefront Manager for Safety & Occupational Health will:

(1) Provide oversight and define any new requirements for grounding or bonding to the RE, the NAVFAC MIDLANT shops and/or other departments/tenants as soon as requirements are made available.

(2) Suspend explosive operations in buildings that fail to adhere to this instruction including all requirements in reference (a).

P. G. BEIERL

Distribution:
List I, II, III (Case A)

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PROCEDURE FOR PERFORMING VISUAL INSPECTION OF LIGHTNING PROTECTION AND GROUNDING SYSTEMS

Required every 6 months:

NAVFAC MIDLANT Shops

1. Check to see that any large metal objects within 6 feet of the lightning masts are connected at their lowest point to the primary ground girdle stub at the lightning mast.

2. Inspect cables connected to lightning masts or lightning mast test pockets to see that they are in good condition and are at least AWG#1/0 or larger, made of bare copper wire, are attached to mast, test pocket ground rod, and no sharp bends in wire. Repair, replace, or install new cables as needed.

3. On lightning-protected buildings, inspect to see that there are no trees in the protected area.

4. If applicable, check condition of ground grab bars (make sure they are not painted) and are installed just outside areas where hazards exist. Randomly inspect all grounding systems connections to see that they are secure and free from paint, corrosion, or foreign materials that may impair ground system efficiency. Make repairs as necessary or electrically test painted or corroded area every 6 months. Inspect both inside and outside of building.

5. Check to see if all flange joints, gasket joints, and all other connecting points have bond jumper cables when they are part of equipment or pipeline processing explosives or flammable materials. Check condition of jumpers. Repair or install new jumpers as needed.

6. Check to see that all metal masses (400 square inches or larger) are connected to the secondary ground girdle. Examples of masses are: radiators, conduits, tanks, downspout, gutters, steam pipe, stationary machinery, stair rails, columns, beams, metal siding, doors, shutters, and trusses. Columns, beams siding, gutters, trusses, etc., shall be connected at their lowest point to the secondary girdle. Repair or add grounding as needed.

7. Check ordnance ground busses, static ground busses, instrumentation ground busses, for clear identification of each, and make sure connections are secured and connection points are free from paint, corrosion, or foreign material that may impair the efficiency of the system.

8. Check to see that conductive chairs, carts, work benches, etc., are identified and clearly labeled as conductive and have inspection dates indicated.

9. Check that installed ground cables are free of defects and in good operating conditions. Where non-translucent insulated cable is used, electrical spot checks should be performed when there is any possibility that the internal cable may be broken.

10. Check to see that all utility lines coming into the buildings are buried the last 50 feet.

11. Check to assure all 120 volt single-phase receptacles installed outdoors or in wet locations are ground fault circuit interrupters.

12. Assure railroad tracks are grounded to secondary girdle adjacent to entering building involved in explosive operation, production operation, and/or segregation renovation operation.

13. Assure crane rail tracks on pier are attached to secondary girdle.

14. Assure railroad tracks within 6 feet of any lightning mast are bonded to that mast. Assure exterior overhead pipelines that enter a lightning protection structure are bonded to the secondary girdle. If pipes come within side-flash distance of the structure they shall be bonded to the secondary grounding system.

15. Assure surge suppressors are installed on all power, communication, data, and process control conductors that enter or exit a facility.

16. Assure all metallic conductors, including intrusion detection lines, water, electrical, steam, air conditioning lines, etc., are run underground the last 50 feet to the building.

17. Assure lightning surge arrestors are installed in explosive buildings and have not been degraded to the point they are no longer effective.

18. Assure the electrical service to an explosive building is arranged so that it can be cut off by switches located at one or more control points outside, but immediately adjacent to the explosive work area.

19. Assure fences are bonded to lightning protection system if they come within side-flash distance as determined by NFPA780. Assure fences are grounded if high-tension lines cross fencing, are directly over head or run parallel to fences. Assure fences are grounded at places where personnel may routinely touch the fence and areas where structure and materials are located within 6 feet of the fence.

20. Review previous test records to assure fences are bonded from gatepost to gatepost, gatepost to gate, and gatepost to secondary ground girdle, if within zone of protection. If outside zone of protection, assure ground rods are driven on each side of gatepost in place of connecting to secondary girdle.

21. Assure there are no ground loops in buildings.

22. Assure conductive floors are free from large cracks and are reasonably smooth and clean.

23. Check to see that all mixers for pyrotechnic, propellant and explosive compositions, screening and sifting devices, assembly and disassembly machines, conveyors, elevators, defusing machines, steel work tables, presses, hoppers, and all associated equipment involved in loading or processing explosive material are bonded to the secondary ground cable.

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PROCEDURE FOR TESTING CONDUCTIVE FLOORS

Required every 24 months:

NAVFAC MIDLANT Shops

WARNING: Instruments for testing the conductivity of floors shall be used inside the room only if the room is free of exposed explosives and no exposed electronic explosive devices (EED's) are present. The floor shall be clean, free of cracks, dry, and the room shall be free of flammable gas mixtures or explosive dust. Have building supervisor remove all ground straps before testing.

1. Test electrodes (2 each), shall weigh 5 pounds. Each shall have a dry, flat, circular contact area of 2 1/2 inch in diameter, and shall have a surface of aluminum or tin foil of a minimum of .0005 inch and backed by a layer of rubber that is 1/4-inch thick and measured between 40 and 60 durometer hardness as determined with a Shore Type A Durometer (ASTM D-2240-68).

2. Calibrated ohmmeter shall operate on a nominal open circuit output of 500 dc volts and short circuit current of 5 milliamperes with an effective internal resistance of 100,000 ohms plus or minus 10 percent.

3. The test leads are to be well insulated and in good repair.

4. When testing conductive floors, use a Biddle earth tester or equal. Test electrode to electrode by placing 2 electrodes 3 feet apart on the floor to be tested. Measure resistance with approved calibrated ohmmeter (mentioned in previous procedures). Five tests of this type shall be performed at different locations on the floor in each room. No test shall read greater than 5,000,000 ohms or less than 5,000 ohms in areas with 110-volt service or less than 10,000 ohms, in areas with 220-volt service, and less than 20,000 ohms in 440-volt service. The average of the 5 tests in each room must be 1,000,000 ohms resistance or less.

5. Test electrode to ground by placing electrode more than 3 feet from any ground point connection or ground object resting on the floor. Connect approved test meter to electrode and to building ground; test resistance. Do this at five different locations and twice at each location by changing leads at tester. The average of the two tests at each location is considered the resistance at

said location. No one resistance reading shall read greater than 5,000,000 ohms or less than 5,000 ohms in areas with 110-volt service, less than 10,000 ohms in areas with 220-volt service, and less than 20,000 ohms in areas with 440-volt service. The average resistance of the 5 readings taken in each room shall be 1,000,000 ohms or less.

6. Fill out inspection report forms, showing all test locations and test results. Report shall also show building number, date, mechanic's name, and show that the floor passed or failed test. Any remarks shall also be noted (repairs, deficiencies, etc.).

7. Deliver original copy to the RE to keep on file.

8. Be sure the building supervisor and Peninsula Storefront for Safety are aware of any floors or grounding systems that failed test.

9. When electrically testing conducive floors, lightning protection systems, or other grounding systems use an instrument specifically designed for earth ground system testing (the instrument must be capable of measuring 1 ohm, +/- 10 percent). Do not use test equipment inside a building with exposed explosives or EED's present.

PROCEDURE FOR TESTING PRIMARY AND SECONDARY GROUNDING SYSTEMS

Required every 24 months unless listed otherwise:

NAVFAC MIDLANT Shops

1. Connection for testing resistance to earth shall be the 3-point fall of potential method with 1 ground rod up to 250 feet from test object and another ground rod inserted 62 percent of this distance in a straight line, if possible. Test point may be established inside of buildings or close to buildings.

2. Test each lightning mast, lightning mast test pocket, and overhead lightning conductors to earth ground using an approved megger (25 ohms or less). Test bonding between lightning mast and any object within 6 feet of mast (1 ohm or less).

3. If possible, disconnect 1 wire from 1 lightning mast or test pockets and test bonding from disconnected wire to connected wire on mast (1 ohm or less). If more than 1 ohm, test bonding between each mast, record results and notify Peninsula Storefront for Safety. Reconnect cable and test bond from wire to mast.

4. Test bonding between primary ground girdle and secondary ground girdle (1 ohm or less).

5. Test electrical resistance from secondary ground girdle to earth ground (25 ohms or less).

6. Test electrical resistance from earth ground to building power ground at panel (25 ohms or less).

7. Test electrical resistance from earth ground to railroad track, gates, fences, and scheduled metal masses (25 ohms or less).

8. Test bonding between secondary ground girdle and all scheduled exterior machines, equipment, conduits, downspouts, gutters, hand rails, beams, metal siding, doors, storage cabinets, railroad tracks, gate, gate post fences, grab bars, steam lines, ramps, metal door stops, grate, vents, antennas, and all other metallic items shown on test plan (1 ohm or less).

9. Test bonding between secondary ground girdle and ordnance ground and/or instrumentation ground (1 ohm or less). Disconnect

lines and test to assure ordnance ground/instrumentation grounds are isolated from all other grounds

10. Test bonding between secondary ground girdle and all scheduled interior machines, equipment, beams, doors, radiators, window frames, tanks, columns, window shutters, mats, tables, static grounds system, mixer, screening and sifting devices, assembly and disassembly machines, conveyors, elevators, defusing machines, presses, hoppers, kettles, paint booths, and all associated equipment involved in loading or processing explosives and explosive materials (1 ohm or less).

11. Test continuity on all ground reels every 24 months (25 ohms or less).

12. Test bonding from fence to gate on each side of gate and from gatepost to gatepost (1 ohm or less). Perform the 3-point fall of potential earth resistance test on at least one gatepost per entry into fenced areas (25 ohms or less).

13. Test resistance on conductive tabletops, mats, and belting. Resistance shall not exceed 1,000,000 ohms. Surface conductivity measurements shall be conducted by those methods used for testing the surface resistance of conductive floors where practical.

14. Where portable equipment is labeled conductive, test electrical resistance from ground to portable equipment, such as chairs and carts. Resistance shall not be greater than 250,000 ohms.

15. On new construction or when replacing transformers for buildings requiring primary/secondary ground systems, the power service ground shall be 25 ohms or less measured by the 3-point method before interconnection to the secondary ground girdle.

16. When performing the 3-point fall of potential earth resistance test, use Table 5.2 of OP-5 for placement of test probes.

PROCEDURE FOR PERSONNEL PERFORMING GROUNDING TESTS

SECTION A. LIGHTNING PROTECTION (MASTS-LIGHTNING RODS)

1. Equipment:

a. Megger Digital Earth Tester DET2/2 or equivalent as per Biddle Instruction Manual 25-TA

b. Cables, 3 each - same manual:

(1) 25 feet red coded.

(2) 62 feet yellow coded.

(3) 100 feet blue coded.

c. Rods (stakes), 2 each, 18 inches hub to point.

2. Test every 24 months per OP5:

a. Prepare megger -

(1) Remove jumper from terminals P2 and C2.

(2) Attach cable (blue) to C2 terminal.

(3) Attach cable (yellow) to P2 terminal.

(4) Attach cable (red) to C1 terminal.

b. Placing rods -

(1) Using the pacing method, place blue cable proper distance from items to be tested. Attach rod by clip and place rods into earth 18 inches deep or deep as possible. (Make sure location is as perpendicular to primary girdle as practical.)

(2) Using the pacing method, place yellow cable 62 percent from item to be tested. Attach by clip and place rod into earth 18 inches deep.

(3) Attach red cable to item being tested.

c. Taking readings; recording -

(1) Switch instrument on and select correct range. Always use most sensitive range possible.

(2) Record readings on applicable forms. System must be 25 ohms or less as per OP-5.

d. Using Megger Digital Earth Tester DET2/2 or equivalent, make sure continuity (less than 1 ohm) exists between all lightning masts and between all large metal masses greater than 400 square inches within the zone protection.

(1) Record readings on applicable floor plans numbering locations of all locations tested.

SECTION B: CHECKING ORDNANCE, POWER, INSTRUMENTATION, AND STATIC GROUNDS

1. Equipment:

a. Megger Digital Earth Tester DET2 or equivalent as per Biddle Instruction Manual 25-Ta.

b. Cables, 2 each.

c. Recording forms.

2. Inspection per OP-5:

a. Visual - performed every 6 months per OP-5.

(1) Make sure secure connections on connection point.

(2) Assure connection points are free from paint, corrosion, or foreign material, if not perform electrical resistance test.

b. Inspect to make sure explosives are not present.

c. Inspect to make sure that portable static cables, installed ground cables, or ground reels are not connected to weapons, etc.

d. Make sure that all sensitive equipment has been disconnected from ground system to be checked.

3. Electric test performed every 24 months as per OP-5.

a. Prepare megger -

(1) Make sure jumpers are connected between P1 and C1 and between P2 and C2.

(2) Switch instrument on and select correct range. Always use most sensitive range possible.

4. Attaching cables:

a. Attach lead to terminal P1 (yellow).

b. Attach opposite end of lead to the system or item to be tested.

c. Attach lead to terminal C2 (blue).

d. Attach opposite end of lead to an established referenced test point.

e. Ascertain all personnel are clear of system or equipment to be checked.

f. Record readings on proper forms. Acceptable reading is 1.0 ohms or less.

g. Disconnect ordnance and instrumentation grounding systems at single source, and make sure systems are isolated from all other grounding sources.

SECTION C: CONDUCTIVE FLOOR TEST PROCEDURE

1. Site Inspection:

a. Check surface for cracks.

b. Check surface for reasonable smoothness.

c. Check surface for cleanliness.

d. Make sure building (room) is free of flammable gasses or explosive dusts.

2. Equipment:

a. Biddle Megger Digital Tester CAT. NO. 210600 suitably calibrated.

b. Two each, 5 pound weights - each covered with aluminum foil resting on 1/4-inch thick rubber pads.

c. Appropriate test leads.

3. Test every 24 months as per OP-5:

a. Electrode to electrode readings are to be taken.

b. Electrode to ground readings are to be taken.

c. Accomplish five or more readings per type of test. Average the results.

d. All measurements must be a least 3 feet from any ground connection.

e. No values greater than 5 meg-ohms are acceptable.

f. Average resistance 1 meg-ohm or less.

g. The average resistance of the conductive floor shall be 1,000,000 ohms or less as measured by the methods described below. The minimum average resistance shall be 5,000 ohm with 110-volt service, 10,000 ohm with 220-volt service 20,000 ohms with 440-volt etc., as measured by the same technique.

4. Placing weights per OP-5.

a. Attach cable ends from megger to each weight.

b. Utilizing the 3-foot spacing, hold cables in front of yourself and allow weights to rest on deck or floor.

c. Ascertain that personnel wearing conductive sole shoes or legstats are not present during testing and that any equipment present will not be damaged by voltage emitted by megger; i.e., computer, etc.

d. Actuate Megger.

e. Record readings on proper forms. Move weights to new location. Repeat b, c, d, and e.

SECTION D: RAILROAD TRACKS: Readings are to be obtained using the methods and equipment mentioned in Section A, Lightning Protection.

SECTION E: MAGAZINES: Readings are to be obtained using the methods and equipment specified in Section A, Lightning Protection, from all exterior metal objects to include vents, conduits, doors,.etc., and recorded on magazine check-off forms.

SECTION F: LIGHTNING PROTECTION - PIERS AND WHARVES

1. Equipment:

a. Megger Digital DET2 or equivalent.

b. Cables, 2 each.

c. Brass plate 14 inches by 14 inches by 1/4 inch attached by nonconductive means (rope) from pier to point 4 feet below water surface and attached to megger lead.

d. Recording forms.

2. Inspection per OP-5:

a. Visual - performed every 6 months.

(1) Assure secure connections. Tug connections.

(2) Connection points free from paint, corrosion, or foreign material.

3. Electrical Test performed every 24 months.

a. Inspect to make sure explosives are not present including loaded rail cars.

b. Inspect to make sure that portable static cables are not connected to weapons, etc.

c. Make sure that all sensitive equipment has been disconnected from ground system to be checked.

d. Coordinate with supervisor before performing any testing.

e. Prepare megger:

(1) Make sure jumpers are connected between P1 and C1 and between P2 and C2.

(2) Switch instrument on and select correct range. Always use most sensitive range possible.

(3) Record readings on applicable forms. System must be 25 ohms or less as per OP-5.

4. Attaching cables:

a. Attach lead to terminal P1 (yellow).

b. Attach opposite end of lead to the system or item to be tested to include all large metal masses, cranes, lightning masts, and railroad tracks. Test railroad tracks every 50 feet.

c. Attach lead to terminal C2 (blue).

d. Attach opposite end of lead to brass submerged into water at 4-foot depth.

e. Ascertain all personnel are clear of system of equipment to be checked.

f. Record readings on proper forms. Maximum acceptable reading in 25 ohms to ground per OP-5 and less than 1 ohm resistance for bonding.